APPENDIX B

ESTIMATING MEDIA CONCENTRATION EQUATIONS AND VARIABLE VALUES

Human Health Risk Assessment Protocol

July 1998

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γ	=	Empirical constant (unitless)
λ_z	=	Dimensionless viscous sublayer thickness (unitless)
μ_a	=	Viscosity of air (g/cm-s)
μ_w	=	Viscosity of water corresponding to water temperature (g/cm-s)
ρ_a	=	Density of air (g/cm^3 or g/m^3)
ρ_w	=	Density of water corresponding to water temperature (g/cm^3)
θ	=	Temperature correction factor (unitless)
θ_{bs}	=	Bed sediment porosity (L volume/L sediment)—unitless
θ_{sw}	=	Soil volumetric water content (mL water/cm^3 soil)
a	=	Empirical intercept coefficient (unitless)
A	=	Surface area of contaminated area (m^2)
A_{beef}	=	Concentration of COPC in beef (mg COPC/kg FW tissue)
$A_{chicken}$	=	Concentration of COPC in chicken meat (mg COPC/kg FW tissue)
A_{egg}	=	Concentration of COPC in eggs (mg COPC/kg FW tissue)
Ah	=	Area planted (m^2)
Ah_i	=	Area planted to *i*th crop (m^2)
A_I	=	Impervious watershed area receiving COPC deposition (m^2)
A_L	=	Total watershed area receiving COPC deposition (m^2)
A_{milk}	=	Concentration of COPC in milk (mg COPC/kg FW tissue)
A_{pork}	=	Concentration of COPC in pork (mg COPC/kg FW tissue)
A_W	=	Water body surface area (m^2)
b	=	Empirical slope coefficient (unitless)
Ba_{beef}	=	Biotransfer factor for beef (day/kg FW tissue)
$Ba_{chicken}$	=	Biotransfer factor for chicken (day/kg FW tissue)
Ba_{eggs}	=	Biotransfer factor for chicken eggs (day/kg FW tissue)
BAF_{fish}	=	Bioaccumulation factor for COPC in fish (L/kg FW tissue)
Ba_{milk}	=	Biotransfer factor for milk (day/kg FW tissue)
Ba_{pork}	=	Biotransfer factor for pork (day/kg FW tissue)
$BCF_{chicken}$	=	Bioconcentration factor for COPC in chicken (mg COPC/kg FW tissue)/(mg COPC/kg feed)—unitless
BCF_{egg}	=	Bioconcentration factor for COPC in eggs (mg COPC/kg FW tissue)/(mg COPC/kg feed)—unitless
BCF_{fish}	=	Bioconcentration factor for COPC in fish (mg COPC/kg FW tissue)/(mg COPC/kg dissolved water)—unitless
BD	=	Soil bulk density (g soil/cm^3 soil)
Br_{ag}	=	Plant-soil bioconcentration factor for aboveground produce (mg COPC/kg DW plant)/(mg COPC/kg soil)—unitless
$Br_{forage/silage/grain}$	=	Plant-soil bioconcentration factor for forage, silage, and grain (mg COPC/kg DW plant)/(mg COPC/kg soil)—unitless
$Br_{rootveg}$	=	Plant-soil bioconcentration factor for belowground produce (mg COPC/kg DW plant)/(mg COPC/kg soil)—unitless
Bs	=	Soil bioavailability factor (unitless)

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$BSAF$	=	Biota-sediment accumulation factor (mg COPC/kg lipid tissue)/(mg COPC/kg sediment)—unitless
Bv_{ag}	=	COPC air-to-plant biotransfer factor for aboveground produce (mg COPC/kg DW plant)/(mg COPC/kg air)—unitless
Bv_{forage}	=	Air-to-plant biotransfer factor for COPC in forage (mg COPC/kg DW plant)/(mg COPC/kg air)—unitless
c	=	Junge constant = 1.7×10^{-4} (atm-cm)
C	=	USLE cover management factor (unitless)
C_a	=	Air concentration (µg/m^3)
C_{acute}	=	Acute air concentration (µg/m^3)
C_{BS}	=	Bed sediment concentration (or bed sediment bulk density) (g/cm^3 or kg/L)
C_d	=	Drag coefficient (unitless)
C_{dw}	=	Dissolved phase water concentration (mg COPC/L water)
C_{fish}	=	Concentration of COPC in fish (mg COPC/kg FW tissue)
C_{hp}	=	Unitized hourly air concentration from vapor phase (µg-s/g-m^3)
C_{hv}	=	Unitized hourly air concentration from particle phase (µg-s/g-m^3)
Cs	=	Average soil concentration over exposure duration (mg COPC/kg soil)
C_{sb}	=	Concentration sorbed to bed sediment (mg COPC/kg sediment)
Cs_{tD}	=	Soil concentration at time *tD* (mg COPC/kg soil)
C_{wctot}	=	Total COPC concentration in water column (mg COPC/L water column)
C_{wtot}	=	Total water body COPC concentration including water column and bed sediment (g COPC/m^3 water body) or (mg/L)
Cyp	=	Unitized yearly average air concentration from particle phase (µg-s/g-m^3)
Cyv	=	Unitized yearly average air concentration from vapor phase (µg-s/g-m^3)
$Cywv$	=	Unitized yearly (water body or watershed) average air concentration from vapor phase (µg-s/g-m^3)
D_a	=	Diffusivity of COPC in air (cm^2/s)
d_{bs}	=	Depth of upper benthic sediment layer (m)
Ds	=	Deposition term (mg COPC/kg soil-yr)
d_{wc}	=	Depth of water column (m)
D_w	=	Diffusivity of COPC in water (cm^2/s)
$Dydp$	=	Unitized yearly average dry deposition from particle phase (s/m^2-yr)
$Dytwp$	=	Unitized yearly (water body or watershed) average total (wet and dry) deposition from particle phase (s/m^2-yr)
$Dywp$	=	Unitized yearly average wet deposition from particle phase (s/m^2-yr)
$Dywv$	=	Unitized yearly average wet deposition from vapor phase (s/m^2-yr)
$Dywwv$	=	Unitized yearly (water body or watershed) average wet deposition from vapor phase (s/m^2-yr)
d_z	=	Total water body depth (m)
ER	=	Soil enrichment ratio (unitless)
E_v	=	Average annual evapotranspiration (cm/yr)

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f_{bs}	=	Fraction of total water body COPC concentration in benthic sediment (unitless)
Fd	=	Fraction of diet that is soil (unitless)
F_i	=	Fraction of plant type *i* grown on contaminated soil and ingested by the animal (unitless)
f_{lipid}	=	Fish lipid content (unitless)
Fw	=	Fraction of COPC wet deposition that adheres to plant surfaces (unitless)
f_{wc}	=	Fraction of total water body COPC concentration in the water column (unitless)
F_v	=	Fraction of COPC air concentration in vapor phase (unitless)
H	=	Henry's Law constant (atm-m^3/mol)
I	=	Average annual irrigation (cm/yr)
k	=	Von Karman's constant (unitless)
K	=	USLE erodibility factor (ton/acre)
k_b	=	Benthic burial rate constant (yr^{-1})
Kd_{bs}	=	Bed sediment/sediment pore water partition coefficient (cm^3 water/g bottom sediment or L water/kg bottom sediment)
Kd_s	=	Soil-water partition coefficient (cm^3 water/g soil)
Kd_{sw}	=	Suspended sediment-surface water partition coefficient (L water/kg suspended sediment)
K_G	=	Gas phase transfer coefficient (m/yr)
K_L	=	Liquid phase transfer coefficient (m/yr)
K_{oc}	=	Soil organic carbon-water partition coefficient (mL water/g soil)
K_{ow}	=	Octanol-water partition coefficient (mg COPC/L octanol)/(mg COPC/L octanol)—unitless
kp	=	Plant surface loss coefficient (yr^{-1})
ks	=	COPC soil loss constant due to all processes (yr^{-1})
kse	=	COPC loss constant due to soil erosion (yr^{-1})
ksg	=	COPC loss constant due to biotic and abiotic degradation (yr^{-1})
ksl	=	COPC loss constant due to leaching (yr^{-1})
ksr	=	COPC loss constant due to surface runoff (yr^{-1})
ksv	=	COPC loss constant due to volatilization (yr^{-1})
k_v	=	Water column volatilization rate constant (yr^{-1})
K_v	=	Overall COPC transfer rate coefficient (m/yr)
k_{wt}	=	Overall total water body dissipation rate constant (yr^{-1})
L_{DEP}	=	Total (wet and dry) particle phase and wet vapor phase COPC direct deposition load to water body (g/yr)
L_{Dif}	=	Vapor phase COPC diffusion (dry deposition) load to water body (g/yr)
L_E	=	Soil erosion load (g/yr)
L_R	=	Runoff load from pervious surfaces (g/yr)
L_{RI}	=	Runoff load from impervious surfaces (g/yr)

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L_T	=	Total COPC load to the water body (including deposition, runoff, and erosion) (g/yr)
LS	=	USLE length-slope factor (unitless)
M_{skin}	=	Mass of a thin (skin) layer of belowground vegetable (g)
$M_{vegetable}$	=	Mass of the entire vegetable (g)
MF	=	Metabolism factor (unitless)
OC_{sed}	=	Fraction of organic carbon in bottom sediment (unitless)
p°_L	=	Liquid phase vapor pressure of chemical (atm)
p°_S	=	Solid phase vapor pressure of chemical (atm)
P	=	Average annual precipitation (cm/yr)
PF	=	USLE supporting practice factor (unitless)
Pd	=	Concentration of COPC in aboveground produce due to direct deposition (mg COPC/kg DW)
P_i	=	Concentration of COPC in plant type *i* ingested by the animal (mg/kg DW)
Pr_{ag}	=	Concentration of COPC in aboveground produce due to root uptake (mg COPC/kg DW)
Pr_{bg}	=	Concentration of COPC in belowground produce due to root uptake (mg COPC/kg DW)
Pv	=	Concentration of COPC in aboveground produce (forage and silage) due to air-to-plant transfer (µg COPC/g DW plant tissue or mg COPC/kg DW plant tissue)
Q	=	COPC emission rate (g/s)
Qp_i	=	Quantity of plant type *i* ingested by the animal (kg DW plant/day)
Qs	=	Quantity of soil ingested by the animal (kg/day)
r	=	Interception fraction—the fraction of material in rain intercepted by vegetation and initially retained (unitless)
R	=	Universal gas constant (atm-m^3/mol-K)
RCF	=	Root concentration factor (µg COPC/g DW plant)/(µg COPC/mL soil water)
RO	=	Average annual surface runoff from pervious areas (cm/yr)
RF	=	USLE rainfall (or erosivity) factor (yr^{-1})
Rp	=	Interception fraction of the edible portion of plant (unitless)
SD	=	Sediment delivery ratio (unitless)
ΔSf	=	Entropy of fusion [$\Delta S_f/R$ = 6.79 (unitless)]
SF	=	Slope factor $(mg/kg\text{-}day)^{-1}$
S_T	=	Whitby's average surface area of particulates (aerosols) = 3.5×10^{-6} cm^2/cm^3 air for background plus local sources = 1.1×10^{-5} cm^2/cm^3 air for urban sources

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T_a	=	Ambient air temperature (K)
T_1	=	Time period at the beginning of combustion (yr)
T_2	=	Length of exposure duration (yr)
tD	=	Time period over which deposition occurs (or time period of combustion) (yr)
T_m	=	Melting point of chemical (K)
Tp	=	Length of plant exposure to deposition per harvest of edible portion of plant (yr)
TSS	=	Total suspended solids concentration (mg/L)
T_{wk}	=	Water body temperature (K)
$t_{1/2}$	=	Half-time of COPC (days)
u	=	Current velocity (m/s)
Vdv	=	Dry deposition velocity (cm/s)
Vf_x	=	Average volumetric flow rate through water body (m^3/yr)
VG_{ag}	=	Empirical correction factor for aboveground produce (forage and silage)(unitless)
$VG_{rootveg}$	=	Empirical correction factor for belowground produce (unitless)
W	=	Average annual wind speed (m/s)
X_e	=	Unit soil loss (kg/m^2-yr)
Yh	=	Dry harvest yield = 1.22×10^{11} kg DW, calculated from the 1993 U.S. average wet weight *Yh* of 1.35×10^{11} kg (USDA 1994b) and a conversion factor of 0.9 (Fries 1994)
Yh_i	=	Harvest yield of *i*th crop (kg DW)
Yp	=	Yield or standing crop biomass of the edible portion of the plant (productivity) (kg DW/m^2)
Z_s	=	Soil mixing zone depth (cm)
0.01	=	Units conversion factor (kg cm^2/mg-m^2)
10^{-6}	=	Units conversion factor (g/µg)
10^{-6}	=	Units conversion factor (kg/mg)
0.31536	=	Units conversion factor (m-g-s/cm-µg-yr)
365	=	Units conversion factor (days/yr)
907.18	=	Units conversion factor (kg/ton)
0.1	=	Units conversion factor (g-kg/cm^2-m^2)
0.001	=	Units conversion factor (kg-cm^2/mg-m^2)
100	=	Units conversion factor (mg-cm^2/kg-cm^2)
1000	=	Units conversion factor (mg/g)
4047	=	Units conversion factor (m^2/acre)
1×10^3	=	Units conversion factor (g/kg)
3.1536×10^7	=	Units conversion factor (s/yr)